ARM
CLIMATE RESEARCH FACILITY

Layered Atlantic Smoke Interactions with Clouds

Smoke contains tiny dark particles that absorb sunlight, warming the atmosphere. But smoke also contains other particles (e.g., organic carbon aerosols) that scatter sunlight so that smoke can both warm and cool the planet. The net effect is difficult to determine. Regional effects can be much more pronounced, and often vary seasonally. One source of smoke—emitted from burning biomass—is especially complicated.

Most of the world's smoky biomass burning emissions arise from wood and grassland fires in Southern Africa. For part of the year, the smoke is advected (moved horizontally) westward over the Atlantic Ocean, reaching as far as Brazil. The perpetually smoky atmosphere overlies one of the largest stratocumulus cloud decks on the planet. Little research exists about how the clouds interact with smoke in this region to affect climate. Many uncertainties contribute to highly variable global aerosol models that a new observational strategy will attempt to resolve.

A new research campaign conducted by the Atmospheric Radiation Measurement (ARM) Climate Research Facility will obtain data midway between Angola and Brazil—the latitude zone for maximum aerosol outflow—at Ascension Island in the South Atlantic Ocean. Warm African winds combine with the cool sea surface temperatures to support a large stratocumulus deck, transitioning to year-round trade-wind shallow cumulus at the location of Ascension Island. These clouds and myriad aerosol-cloud-radiation interactions will be studied.

LASIC will operate out of Ascension Island, nearly midway between Africa and Brazil. A British territory, the island supports British and American air forces, communications, space agencies, and global positioning system navigation.

Fires consume much of Africa's grasslands, emitting large amounts of smoke, the effects of which can be felt as far away as Ascension Island and even Brazil.

Using a portable observatory, or ARM Mobile Facility (AMF), that contains some of most advanced atmospheric research instrumentation for cloud, aerosol, and atmospheric profiling, researchers will measure clouds, aerosol particles, and radiant energy.

The ARM Facility, a national scientific user facility managed by the U.S. Department of Energy (DOE) Office of Science, will conduct the **Layered Atlantic Smoke Interactions with Clouds (LASIC)** from June 2016 through October of 2017.

Ascension Island is strategically located to collect high-resolution measurements to resolve uncertainties in the aging and transport of smoke and low cloud response. Collocated smoke and clouds over the remote ocean represent a regime of significant climatic importance that has not been studied with comprehensive surface-based measurements.

Science Objective

The goal of the LASIC campaign is to improve understanding of aged carbonaceous aerosol and the mechanisms by which clouds adjust to the presence of aerosol. LASIC will:

- improve current knowledge on aged aerosols from biomass burning and their radiative properties;
- use surface-based remote sensing to measure relative vertical location of aerosols and clouds;
- improve our understanding of the cloud adjustments to the presence of shortwave-absorbing aerosol within the vertical column, both through aerosol radiation and through aerosol-cloud interactions; and
- assess the transition of the cloudy boundary layer from the upwind stratocumulus deck to cumulus under a wide range of atmospheric aerosol conditions as well as large-scale environmental conditions.

Research Instrumentation

Onsite operators monitor and maintain the facility to assure the best and most complete data set are acquired. Data are collected 24-hours a day, every day, and provided free of charge online to scientists worldwide.

Measurement capabilities include cutting-edge meteorological instrumentation, a broadband and spectral radiometer suite, and remote sensing instruments, such as:

- K- and W-band Zenith pointing Radar
- Micropulse Lidar
- Laser Ceilometer
- Microwave Radiometer
- Atmospheric Emitted Radiance Interferometer
- Multifilter Rotating Shadowband Radiometer
- Sky Radiation System–a collection of radiometers to measure visible diffuse, global, and direct visible and infrared solar radiation
- Balloon-Borne Sounding System–sondes launched each day at regular intervals

- Radar Wind Profiler
- Total Sky Imager
- Aerosol Observing System
- Surface Meteorology Station.

Collaboration

An international team of scientists from the United States—funded by National Aeronautics and Space Administration—United Kingdom, France, South Africa, and Namibia will be coordinating with LASIC scientists to better understand absorbing aerosol's impact on climate.

As part of this international collaboration, multiple aircraft will be based in Namibia during the LASIC campaign. Further, a dedicated surface-based instrumentation suite will be deployed on St. Helena to complement the measurements collected at Ascension Island. This combined data set will further improve understanding of low cloud behavior as it transitions from stratocumulus to trade-wind cumulus.

http://www.arm.gov/campaigns/amf2016lasic

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